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Barriers to Value-Addition in "Omena" Fisheries Value Chain in Kenya

[1]Mathew Muma, [2]Harrison Charo-Karisa

[1]Kenya Institute for Public Policy Research and Analysis (KIPPRA), P.O.Box 56445-00200, Nairobi, Kenya.
E-mail: mumadr@gmail.com
[2]World Fish, Egypt and Nigeria, Abbassa, Abou Hamad, Sharkia 44662, Egypt.
E-mail: harrison.charo@gmail.com

1. Abstract

The purpose of this study was to document barriers to value addition in *Rastreneobola argentea* ("Omena") fisheries value chain in Kenya. The study was undertaken in Suba sub-county where most Omena is produced in the Kenyan side of Lake Victoria. Economic, cultural, governance, innovation, legal, policy and social issues among others which impact negatively on value addition in the fisheries value chain were investigated. The value chain included Omena marketing channels found in the main towns and cities in Nyanza and Western regions and also in Nairobi, Nakuru and Mombasa cities. Qualitative expert interviews with key informants in the Omena value chains and descriptive secondary data were used under a value chain analytical perspective. Barriers to value addition in the value chains included; poor processing technologies, lack of market information, lack of legal and policy framework for Omena processing, poor value chain stakeholder business skills, land inaccess and poor infrastructure development as well as lack of technical specifications for processing and marketing of Omena. Policy and legal framework for land use at the beaches and standards for processing dry Omena are needed to enhance infrastructure development at beaches and processing of high quality and safe Omena products. Appropriate technical specifications for Omena processing and handling, transportation, distribution and marketing of the product should be developed and adopted to ensure high product quality and food safety.

Keywords: Barriers to value addition; Dagaa; Fish processing; Fish value added; Fish value addition; Fish value chain; Mukene; Omena.

2. Introduction

2.1 Background

Lake Victoria, the second largest fresh water lake in the world, straddles the three East African countries of Kenya, Uganda and Tanzania. The fishery based on *Rastreneobola argentea* species locally known as "Omena" in Kenya, "Dagaa" in Tanzania and "Mukene" in Uganda, ranks second after Nile Perch (*Lates Niloticus*) in economic contribution to income, employment and food security to the local riparian populations (Ibengwe and Kristófersson, 2012; FAO, 2011; Kabahenda *et al*., 2009). Landing of Omena by weight reached over 60 percent of all total fish landings in Kenya in 2011 and has

continued to be an important fishery (Farm Africa, 2016; Ojwang *et al*., 2014; Republic of Kenya, 2011). Artisanal production of the fishery dominates in the three East African countries.

The Kenya Government through the Fisheries Policy Framework aims at enhancement of the oceans and fisheries sector to contribute to wealth creation, increased employment for especially youth and women, food and nutrition security, and revenue generation. This is realized through effective private, public and community partnerships. The fishery policy framework promotes fish filleting for export, rationalization of tariffs on inputs for fish processing and development of fishery infrastructure among others (Republic of Kenya, 2008). Omena fishery is recognized as a key contributor to domestic food providing annually 30 percent and 70 percent of the available fish for human food and livestock feed, respectively (FAO, 2011; Karuga *et al*., 2003). Omena provides 3-5 kg (35 percent) of the per capita proteins obtained from fish (Ojwang *et al*., 2014).

Inland fisheries (lakes and riverine), marine fishery and aquaculture currently contribute 0.8 percent of the Gross Domestic Product (GDP) (KMFRI, 2017). It has been argued that fishery contribution to the GDP could be doubled if post-harvest losses (20-50 percent or more for Omena depending on season) are addressed. Although the value of post-harvest losses for Omena has not been estimated for Kenya, it is estimated at $32 billion annually for the three riparian countries (Ibengwe and Kristófersson, 2012). Unlike the Nile Perch, which is mainly exported, Omena is for domestic consumption. It is affordable and important as a source of rich proteins and source of employment to the local riparian community. Women dominate in small-scale post-harvest processing and in marketing and sale of Omena (Ojwang *et al*., 2014).

Overfishing due to over-commercialization of the fisheries has overall led to the decline of the main fisheries including Omena fisheries down from the levels of 1980s-90s (Farm Africa, 2016; Lawrence, 2015; Othina and Osewe, 1996). Thus the domestic demand for Omena and food security among the riparian communities can no longer be met. In addition to post-harvest losses, the above has made fisherfolk shift to farming as a means of livelihood (Republic of Kenya, 2009).

The main constraints to the overall fishery industry include; inefficiencies in fishery resource management; depletion of fresh water fish stocks; lack of infrastructure such as cold storage, roads, processing facilities and electricity (Kabahenda *et al*., 2009); inadequate budgetary provisions, research-extension services, and invasion of Lake Victoria by water hyacinth. The latter has resulted to environmental degradation affecting production through aquatic environment change and blockage of fishing grounds (Republic of Kenya, 2010).

Due to lack of proper facilities and value addition, a substantial amount of Omena gets rejected and lost to consumption (Manyala and Adoyo, 2011; FAO, 2014). Small-scale and industrial processors typically reject 15-25 percent of the fish recovering only 12 percent of the reject. The proportion of high-quality product for human food from the catch is estimated at under 10 percent of the total catch (FAO, 2011) with about 70 percent of the catch channeled to animal feed processing. Harvesting and handling of Omena without chilling and hygienic facilities at landing, processing and marketing sites leads to bacterial, mold and fungal contamination of the fish (Onyango *et al*., 2015; Owaga *et al*., 2009, 2015; Manyala and Adoyo, 2011; FAO, 2008, 2014). Partial sun drying on grass and rocks has been shown to lead to substantial post-harvest losses (15-50 percent) and contamination with yeast and molds (Nkondola, 2016) than fish treated with salt and chlorinated water and oven dried (Sifuna *et al*., 2008; Owaga *et al*., 2009).

Understanding barriers to processing of Omena and handling practices in Kenya is important for many reasons. Omena is highly perishable, ranks as the most important fishery to the local Lake Victoria riparian community and is affordable to the poor. Additionally, it has potential for earning more income from exports to the East and Central African region than other commercial fish species (Kabahenda *et al*., 2009). Analyzing barriers to Omena value-addition and value added can contribute to the Fisheries Policy Framework. It can guide a strategy to contribute to a sustainable, efficient and effective fishery value chain where benefits are shared equitably among stakeholders (Kariuki, 2011; Trienekens, 2011). The study was based in Suba Sub-county in Homa-Bay County because it contributes most of the Omena landings in Kenya (Table 1).

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Table 1: Omena landings from Suba Sub-county and Lakewide in Kenya, 2007-2014

Omena landings (metric tons)				
	Suba Sub-county		Lake wide	
Year	Quantity Metric tons	Ex-vessel value 000 Kshs	Quantity Metric tons	Ex-vessel value 000 Kshs
2007	22,400	464,999	49,438	1,269,451
2008	21,280	604,499	46,966	1,650,256
2009	21,638	973,704	49,326	2,219,624
2010	29,632	1,333,440	47,716	2,225,780
2011	50,316	2,186,272	72,314	3,224,846
2012	25,158	2,813,882	52,948	2,813,882
2013	19,969	629,031	66,717	3,552,513
2014	20,050	801,994	63,993	3,407,456

Source: Adapted from Suba Sub-county Fisheries Annual Report, 2011, Republic of Kenya, 2011, 2012a, b, 2013, 2014.

*Note:*000 = 1000 times; Kshs. = Kenya shillings

3. Review of Literature

3.1 General

Estimates for Omena stakeholders in Kenya's side of L. Victoria were put at; 12,724 fishermen, 25,448 small scale processors, 5,896 wholesalers, 50,896 retailers and over 2 million employed. The value chain is underdeveloped in safe handling, processing, cold storage, grading, packaging and product development (USAID, 2010; Hempel, 2010). The products mainly consist of medium and high-grade food. Industrial processing of Omena adds most value to low and medium grade animal and high-grade pet feeds (Kariuki, 2011). The capital outlay for starting Omena business ranges from $10 for a small-scale processor to $ 10,000 for a processor. The businesses especially upstream ones are limited by access to capital for production, processing and marketing (USAID, 2008, 2010). The government, NGOs, and microfinance institutions have mainly played roles in product development, microfinance, market development and support services such as inputs. The main market for the fishery is the urban areas in western Kenya (Republic of Kenya, 2011). The market for animal feed is in Nairobi and other major cities. The ability of some of the players to adopt innovations in processing that ensure quality, safety, marketability and income from the products represents a major opportunity for the fishery (Manyala and Adoyo, 2011; FAO, 2014).

4.2 Theoretical literature

Theoretical and empirical literature that address post-harvest losses/value addition in relation to *Rastreneobola argentea* or similar fishery value chains in East Africa and globally was reviewed to guide the study. A value chain perspective was adopted. A value chain can be analyzed from discovering the relationships and causal effects among linked value chain activities (Hempel, 2010). Trienekens (2011) conceptualizes a framework for analyzing a value chain that comprise of *Value chain analysis constraints*, *Value chain upgrading* and *Value chain analysis*.

Value chain constraints represent market access, market orientation (meeting diverse market needs), resource availability, institutional voids and infrastructures. *Value chain upgrading* is the process of making a firm or economy more profitable and/or move to technologically sophisticated capital and skill-intensive economic niches (McDermott, 2007, cited in Trienekens, 2011). *Value chain analysis* characterizes a value chain in terms of its network structure, value added (high, quality, cost and delivery time etc.) and governance form. The rest of literature outlines the Omena value chain in Suba

Sub-county in terms technology, stakeholders, network structure, activities, costs, resources and institutions. Local and other literature regarding value chain analysis and constraints are then presented. Knowledge gap is then clarified.

4.3 Empirical literature

Further empirical literature for understanding the value chain is elaborated below. The impact of fish quality on value addition was explored by Calanche *et al*. (2013) who evaluated quality issues in fresh salmon and sardine processing and marketing in Spain as a function of cold storage manufacturing. The researchers concluded that the standard measure for freshness of the finished products was determined by raw material quality and not manufacturing practices. Raw material handling is therefore a form of value addition as it minimizes post-harvest losses and enhances quality of the various value-added products (Kumolu-Johnson and Ndimile, 2011). Minimizing post-harvest losses can ensure realization of food and nutrition security policy for Kenya as more income and fish is available.

The quality, appearance, taste, texture and acceptability of the various products resulting from processing fish by various methods to address post-harvest losses have been documented among key stakeholders of the relevant fishery value chains including sardines and Omena. The methods include oven drying brined fish, oven drying salted sardines/Omena (Bellagha *et al*., 2007; Kabahenda, 2009), smoking salted spiced Omena and smoking brined Omena (Mhongole and Mhina, 2012). Other techniques for adding value to fish included sun-drying salted product (Ofulla *et al*., 2011; Bellagha *et al*., 2007), smoking salted spiced product (Bille and Shemkai, 2006), deep frying Omena in different culinary fats (Ofulla *et al*., 2011; Sánchez-Muniz *et al*., 1992), sun-drying Omena on racks of wire mesh, and a piloted solar drying of Omena on ultra violet treated polythene (WIFIP, 2012; Jumbe *et al*., 2010).

The quality products of sardines and Omena above were found to be in high demand and of premium price relative to less preferred products of the same fisheries in real life situations (Kariuki, 2011; Bellagha *et al*., 2007; Roheim *et al*., 2007; Bille and Shemkai, 2006) and in surveys (Calache *et al*., 2013; Mhongole and Mhina, 2012; Manyala and Adoyo, 2011; Kabahenda *et al*., 2009). The products had acceptable microbial levels of contamination. Further, some studies have provided evidence on how demand for Omena and value addition occurred from mixing ground powder of the fish with other foods for preparation of fortified meals for malnourished children and meals such as porridge, soups, and stews (Konyole, *et al*., 2012; Mbabazi and Wasswa, 2010). In addition, Roheim *et al*. (2007) found statistical results generally indicating value addition at the retail for frozen seafood segment including sardines that resulted in product prices that were dependent on the attributes of value addition such as product forms (fillets, steaks, nuggets, and cakes), produce brands and package sizes. Research has also indicated that by-products from Omena such as anti-oxidants, cosmetics, lubricants, varnishes, soap and others can be prepared and added to food systems and as well pharmaceutical and nutraceutical products (Ogonda *et al*., 2014; Mhongole and Mhina, 2012). The by-products have greater value than the value of the raw commodity.

Studies on Omena and other similar fishery market performances have made several findings and implications for a sustainable fishery value chain in terms of equitable benefits to stakeholders, costs and value addition. An artisanal Moroccan sea fishery value chain including sardines found benefits, costs and value added to the various fish species fairly well-distributed among the stakeholders who had better linkages (INFOSAMAK, 2010). This is contrary to the situation of Omena in Kenya (Manyala and Adoyo, 2011; Kariuki, 2011). In analyzing the Omena market in Kenya in several studies, there were challenges regarding; standards for grading and processing of the raw material for human and animal feed, limited value addition activities in drying and storage among only small-scale fish processors and wholesalers, proven processing technology, and savings for investments (Kariuki, 2011; Manyala and Gitonga, 2008).

Other constraints to value addition in Omena fishery have included; poor storage infrastructure, lack of adequate fuel wood, lack of ready market for the product and lack of product development that include salt, chilly and spices and product promotion. Finally, two studies by USAID found the fishery had potential for profitability. The studies made recommendations for the need to enhance financial and governance structures and address socio-cultural and environmental concerns for the riparian communities (USAID, 2008, 2010).

This literature review indicates a high business and food supply potential of the fishery, the possibility to add value from post-harvest losses (15-50 percent) and the associated generation of income, employment and nutrition. Barriers to value addition and value added are key knowledge gaps. The research questions were: what are the barriers to value addition in the Omena value chain in Kenya? What value is added to Omena in the value chain? What are the policy implications? The study methodology is presented followed by results and discussion.

5. Methodology

The concept barriers to value-addition in "Omena" fisheries value chain was used in this study to describe any social, economic, technological, governance (policy, legal issues), cultural, and power relations issues among others which impact the value chain. A value chain comprises of all the activities required to realize a product or service from production initiation stage to the various phases of production and consumption to product disposal. The study used value chain

analytical perspective to uncover the causal relationships among activities in production, processing, marketing and consumption stages of the Omena value chain with specific focus on barriers to value-addition and value-addition. The value-chain perspective postulates that appropriate linking of activities and stakeholders in the core of the value chain and the upstream and downstream will lead to a sum of added value of the value chain that is greater than the individual sums of added value for each activity in the different stages of the value chain (Hempel, 2010). In case of fisheries, the stakeholders include fishermen, small-scale and large processors, wholesalers, stockists, and retailers.

5.1 Study Area

The study was conducted for Suba sub-county and also in isolated counties in which Omena fish from Suba sub-county was a major part of the overall fishery value chain. Suba, Bondo Sub-counties and Busia County lead in Omena production in the country with Suba contributing 30-70% of the total production (Table 1). Samples of respondents for the studies used as sources of secondary data (sampling was random or purposive) varied between 63 and 200 stakeholders. The data and information were supplemented by primary data and information (qualitative and quantitative) from interviews with 15 key informants involved in the value chain (5 officials and 10 value chain stakeholders). Six mainly descriptive studies, which investigated financial needs for the fishery, challenges, opportunities, processing and/or value-addition in the value chain, were used to determine barriers to value-addition.

5.2 Conceptual Model

A generalized conceptual model for the analysis is presented in Figure 1. The analytical framework was adopted because a value chain is affected by downstream and upstream activities, stakeholders and their relationships. Analysis of linkages among activities and roles of stakeholders in the value chain can help to uncover the causal relationships among them and thus barriers to value-addition. Identification of barriers to value addition and value added along the value chain, was done through answers about different activities, stakeholders, costs and processes along the value chain.

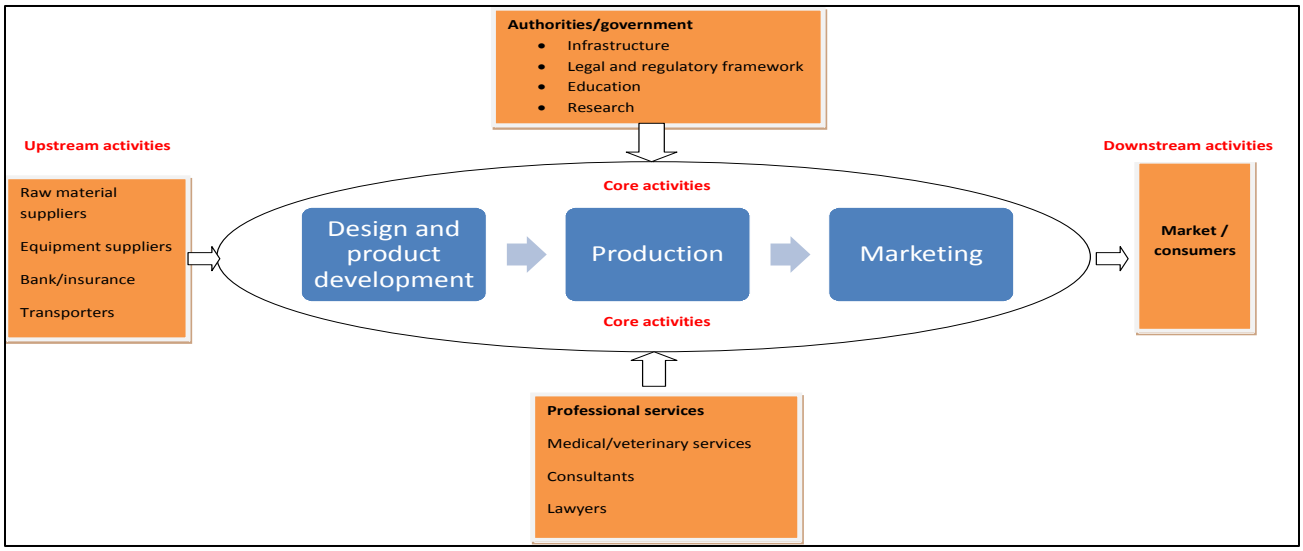

Figure 1: A generalized value chain model

6. Data Analysis

6.1 Statistical and Qualitative Data Analysis

Data on barriers to value addition was analyzed using descriptive statistics and by ranking from qualitative results of value chain stakeholder responses on barrier factors. The barrier factors were reviewed from local, regional and international literature on Omena value chains or similar fishery value chains. Analysis for value added along Omena value chain was done using price margins and costs for value addition activities for consecutive value addition stages. Weighted averages for stakeholders' responses to question items on main barriers were computed from frequencies (means) of the number of positive responses on a barrier factor and sample sizes when at least two studies had responses on the same barrier. Key stakeholder (5 service providers and 10 small scale processors, wholesalers/stockists, industrial processors (Omena consumers) interview results on barrier factors were used to rank and validate the descriptive statistical data on barriers. Qualitative data was synthesized by content analysis. Studies on barriers to value-addition with qualitative validation by stakeholders of barriers to value-addition were also documented along responses in which frequencies for a factor were documented. The patterns for weighted averages and the associated focus group findings were described to shed more light

into the findings. The literature review for studies on barriers to value addition and value added was used to elaborate on the barriers for the different stakeholders under study results. Results for the weighted averages, stakeholder interviews and workshop validation on barriers by other studies are shown (Table 2). Data was analyzed as frequencies (means) and weighted average of frequencies (means).

6.2 Data Sources

Secondary data on Omena fisheries in Kenya was mainly used to analyze barriers to Omena value addition and value added. The data used was from a population of stakeholders in production, processing, transportation, marketing and consumers of Omena fisheries. Qualitative data from interviews using a semi-structured questionnaire was also obtained from 5 professionals and 10 individual stakeholders from the value chain.

6.3 Analytical Model

In estimating value added to the Omena value chain, a cost chain model was used to assess value addition from production through to domestic and industrial consumption. C_1, C_2, C_3, C_4 represented various costs such as: C_1 = costs of fishing and landing fish or production (sorting, etc); C_2 = primary processing and transfer to secondary processing site to wholesalers (sorting, cleaning, drying, etc); C_3 = secondary processing at wholesale and transfer to retailers, stockists, industrial processors (partial drying, packaging, transportation); and C_4 = tertiary processing and transfer to consumers/tertiary processing by industrial processors and transfer to animal feed consumers.

A value chain analysis was undertaken for the various cost components to estimate the different value-added components at each stage of the value chain. From the Theory of the Firm in production economics, the following assumptions were made; Price (p) = Marginal cost = Marginal revenue (R) under competitive market conditions and Value = (price * quantity). The values of the commodities at different stages of the value chain were defined as follows;

(i) V_j=value of commodity j in the absence of activity i;

(ii) V_{j*} = value of the commodity j after undertaking activity i on commodity j;

Then the proportion of value added (VA) to commodity j after activity i is given as follows;

(i) Let quantity of Omena loaded at production site be Q_0 whose cost is $C_1 = P_0$. Then the value of the fish is $P_0 Q_0$ (First degree processing);

(ii) Let the quantity of fish at primary processing (being quantity of fish obtained from fishermen after primary processing) be Q_1 whose cost of processing and transfer to secondary processing is $C_2 = P_1$. Then its value V_{j*} is $P_1 Q_1$ (Second degree processing). The proportion of value added after primary processing ((Second degree processing) is then

$$VA = \left[\frac{\left(P_1 Q_1 - P_0 Q_0 \right)}{P_0 Q_0} \right] * 100\%;$$

(iii) The value added after secondary processing (Third degree processing) at wholesale is given by;

$$VA = \left[\frac{\left(P_2 Q_2 - P_1 Q_1 \right)}{P_1 Q_1} \right] * 100\%$$

(iv) Similarly, the value added at tertiary level processing (retail and industrial/animal feed processing, fourth degree processing) is given by;

$$VA = \left[\frac{\left(P_3 Q_3 - P_2 Q_2 \right)}{P_2 Q_2} \right] * 100\%$$

7. RESULTS

7.1 Descriptive Statistics for Barriers to Value-Addition and Stakeholder Validation of Barriers to Value-Addition

A summary of descriptive statistics from the literature and from our key informants and focus group discussions on some barriers to value addition in Kenya is provided in Table 2. Barriers to value addition in Omena fishery value chain during the period 2008-2011 and those validated by key informants (this study) were; lack of appropriate technology for sun drying Omena, poor adoption of a new piloted technology, lack of legal and policy framework for processing dry Omena,

inadequate entrepreneurial skills among stakeholders in the value chain and under development of infrastructures for fish handling. Other barriers were lack of market information, stakeholder linkages and standards for handling Omena for human and animal feeds. The weighted averages, calculated from a combination of secondary data, validation workshop/focus group results and inferential analyses, indicate that constraints crucial for value addition in the value chain have not changed over the years.

The following barriers to value addition were found to impact Omena value addition and were characterized with the patterns described here; each of five out of 11 barriers to value addition (items of barriers to value addition 3, 8, 9, 10, 11) was confirmed as a crucial issue statistically by at least two descriptive studies using appropriate samples of value chain stakeholders. Each of two of the 11 factors (items of barriers to value addition 1, 5) was documented with one descriptive study and the factor was supported by at least three stakeholder validation/focus group workshops. Two factors each (2,6) were supported by at least four stakeholder validation studies; and two factors each (barrier items 4,7) were supported by at least two stakeholder validation/focus group studies and/or with a statistical significance result.

The lack of proven technology for processing Omena was evidenced by several studies, which tested methods for handling and processing Omena by various methods in comparison to the traditional sun drying of the fish on rocks, sand and grass in East Africa. These studies found that methods such as brining, salting and sun drying and hot smoking of Omena gave better quality product than sun drying (Mhongole and Mhina, 2012; Kabahenda, 2009; Bellagha *et al*., 2007; Bille and Shemkai, 2006).

The studies also found almost all the other issues identified in the present study ranging from lack of policy framework for drying Omena, poor adoption of appropriate technology to inadequate land for sun drying Omena and poor infrastructures for cold storage among others. In particular, studies by Kabahenda (2009), Mhongole and Mhina (2012) and Calache *et al*. (2013) found barriers to value addition ranging from hygiene, lack of standards for handling fish, inadequate market information about consumer preferences for differentiated products to unhygienic transportation and storage as barriers to value addition.

Table 2: Descriptive statistics for barriers to value-addition in Omena value chain in Kenya

No.	Barrier to Value Addition	Study and year	Sample Size *N*	Frequency *F (%)*	Weighted average (%)
1	Lack of proven technology for drying	[a]	200	*	-
		[b]	63	95	
		[c]	168	*	
		[d]	69	*	
2	Legal and policy framework for Omena processing	[a]	200	*	-
		[b]	63	*	
		[c, d]	168(69)	*(*)	
3	Poor adoption of pilot/appropriate drying technology	[a]	200	57	65.3
		[b]	63	93	
		[c, d]	168(69)	*(*)	
		[e]	175	**	
		[f]		**	
4	Inadequate land/space for drying	[a]	200	*	-
		[b]	63	95	
		[d]	69	*	
5	Poor infrastructures for cold storage	[a]	200	*	-
		[b]	63	95	
		[c]	168	*	
		[d]	69	*	
6	Inadequate entrepreneurial skills	[a]	200	*	-
		[b]	63	*	
		[c, d]	168(69)	*(*)	
7	Inadequate market information and linkages	[a]	200	*	-
		[b]	63	93	
		[c]	168	*	
		[e]	175	**	

8	Poor product quality/Lack of standards for handling (drying and storage etc.)	[a]	200	*	84.8
		[b]	63	96	
		[c, d]	168(69)	*(*)	
		[e]	175	80.8	
		[f]		**	
9	Lack of differentiated Omena products	[a]	200	99	99.5
		[b]	63	*	
		[c, d]	168(69)	*	
		[e]	175	100	
10	Poor transportation	[a]	200	*	95
		[b]	63	95	
		[c, d]	168(69)	*(*)	
		[e]	175	95	
11	Access to credit	[a]	200	*	25^1
		[b]	63	20^1	
		[c, d]	168(69)	31^1(*)	
		[e]	175	21^1	

Source: Own compilation

Note: [a] = Manyala and Adoyo, 2011; [b] = Manyala and Gitonga, 2008; [c] = USAID, 2010; [d] =;

USAID, 2008 =; [e] = Kariuki, 2011; [f] = Waga *et al*., 2009; * = Barrier validated by key informants; [1] = Proportion of finance for business from formal credit; ** = Study with significant Inferential results; N = sample size of fishery stakeholders studied; *F* = Frequency of the variable measured; % = percent.

7.2 Causatives of Barriers to Value Addition in Omena

The major groups highlighted as suffering most from lack of value addition are small scale processors, wholesalers and feed producers. These spoilage processes continue on the product in the value chain segment involving these categories. Wholesalers usually receive their fish from small processors and bulk them for supply to processors. A large part of the bulked fish suffers further post-harvest losses.

7.2.1 Small Scale Processors

The main barriers to value addition for small processors are poor quality Omena due to bacterial contamination, lack of land ownership, lack of access to investment capital, poor infrastructure, poor adoption of improved sun drying technology using improved racks, local culture negating savings and investments, inappropriate units of measurements for Omena and high levies charged to small processors and other players. Lands for beaches in Lake Victoria part of Kenya are owned by County Governments. Titles for such lands are in most cases not issued to County Governments. This makes land access and infrastructure development ambiguous. Policy and legal framework for land use at beaches are needed to facilitate infrastructure development at beaches and processing of Omena for achievement of food quality and safety.

In addition, lack of cooperative institutions to encourage and demonstrate entrepreneurial skills in leadership, technical skills, business management, market information on consumer preferences and linkages among market players is a barrier to value addition. To this end, the County Cooperative Development funds established by schedule 4 of the Kenya Constitution which had no allocated funds at the counties at the time of the study can go a long way in enhancing entrepreneurial skills (Manyala and Adoyo, 2011). Further, poor fish quality is represented mainly by crude protein content (CP) of Omena which is less than 55 percent, 10 percent moisture content or more and sand and debris contamination which is 1 percent or more of the product weight. Inadequate processing of Omena through sun drying and quality product processing are related to landownership, poor access to investment capital by processors and lack of infrastructural development policy at fish landing beaches (Table 2).

The poor adoption of improved racks (Manyala and Adoyo, 2011) can be attributed to institutional arrangements for innovation adoption, innovation characteristics, adopter characteristics, and the social nature of a community in which an innovation is being introduced and how it affects diffusion of an innovation (Rogers, 1995) among others. Insights should be developed as to which issues among the above can be used to address adoption problems.

The market information problems of what is in demand, product price and place of demand are mainly caused by underdevelopment of the value chain and lack of interest of Omena players in parts of the value chains patronized by others (Table 2). Lack of market information was found to be preventing value addition to the product and equitable distribution

of benefits among players in the market. Lack of linkages among market players without legal statuses in the value chain except for feed processors affects business stability and legally guaranteed relations. This affects stable demand and supply situation (Manyala and Adoyo, 2011). The units of measurements adopted for Omena transactions among players other than feed processors have varying weight measurements and value for money depending on the degree to which the product is dried. This leads to varying profits for same fish quantity.

7.2.2 Wholesalers

The barriers to value addition regarding sun drying of Omena also apply to wholesalers. The contamination of partially dried Omena and its effect on quality and relationship to value-addition therefore multiplies for wholesalers along the value chain. The other barriers to value addition for wholesalers are linked to transportation and storage. Barriers to processing by drying include lack of space and facilities in which bulk drying can be undertaken at landing beaches or near storage facilities for Omena (Table 1).

Drying space problem is caused by local government policies as already explained. The problem is compounded by a lack of ownership of land at the landing beaches and the manner in which access rights are given and utilization of the land and other facilities are guaranteed. Moreover, there are no locally agreed scientifically based specifications (standards) by stakeholders in the Omena sub-sector on how the product should be dried and handled so that quality, sanitary and safety requirements are met. The materials for packaging Omena should be safe from microbiological, physical and chemical contamination (Owaga *et al*., 2009). Although the Ministry of Health issues health certificates to all categories of stakeholders that are involved in commercial handling and exploitation of fish or Omena, no education on safe fish storage, handling and transportation is provided to the businessmen and no enforcements for these.

7.2.3 Industrial Processors

The poor handling in sun drying of Omena at the landing beaches and continuation of biodegradation at storage by wholesalers lead to a loss of over 80 percent of rejected Omena. Here, barriers to value addition result from lack of policy and legal framework for dry fish standards for human and animals for the export and domestic markets (Table 1). The huge regional market potential for the fish is lost because no value addition and trade in fish products can occur without compliance to the relevant importation standards. For the domestic market, losses are incurred from costs for re-processing of poor-quality product and time loss. Such standards should be established and regularly reviewed by the Kenya Bureau of Standards through appropriately composed technical committee (Manyala and Gitonga, 2008).

7.3 Value Addition in Omena Value Chain

Value addition activities at different stages of the value chain (production, primary processing, secondary processing, and processing for production consumption (industrial/animal feed processing and human food processing) for which value added were analyzed are first briefly described here followed by results for the value addition for the Omena value chain. Production activities contributing to Omena value addition include appropriate storage and timely landing of the fish which minimize physical and chemical spoilage of the product. Primary processing stage of the value chain involve small processors cleaning the fish with lake water to remove sand and debris. Omena is then dried on grass, mats and raised racks for high quality fish. Sorting is further performed to remove sand and debris from the final product.

For secondary processing, small quantities of Omena are collected and bulked by wholesalers from small processors and stored by the landing sites or in urban markets or towns near the beaches. Some further drying of the product is undertaken. Packaging is done and storage as well. Transportation of the product to larger wholesalers or direct delivery of the product to industrial processors is then undertaken. In tertiary processing, Omena is processed into high and medium quality human food and as salted, spiced or stewed product. The products are sold unpackaged or packaged in polythene bags in different sizes. For animal feed production, the fish is re-processed to remove debris, sand etc. Re-sorting and re-processing are then done. Drying and sieving are then performed. The fish is then grinded and formulated into a ration with grinded maize, minerals, vitamins and pre-mixes. Transportation of the animal feed and storage are done. Values added on average for the three stages of value chain mentioned were computed.

Literature indicates that about 70 and 30 percent of Omena is consumed by the animal feed industry and human consumers, respectively. About 8 percent of the Omena production in Kenya is imported from Tanzania and Uganda. Also, the literature has indicated that currently, there are minimal or no exports of "Omena'" from Kenya to any other country. Additionally, no estimates have been made regarding losses of the product for human consumption. This is the case since the product for human consumption is known to generally meet high quality standards as there are many options of choice for consumers. Any low-quality product is always channeled to animal feed manufacturing. Loss of product related to value addition is therefore assumed to be minimal. It can therefore be assumed that costs incurred in value addition in Omena related mainly to the animal feed manufacturing industry.

The following assumptions were made in estimating value added at the various stages of the Omena value chain.

1. Value of total production in Suba subcounty (Ksh.) = 2,186,272,000 (2.186 Billion) in 2011.
2. Profit margins for small scale processor and wholesaler are, respectively, 37% and 79% (USAID, 2010).
3. Dry product from 2011 production (Suba Subcounty) = 50,316*1/3 = 16,604.28 tons.
4. Dry product available for human consumption (30% total dry product catch) = 16,604.28*.3 = 4981.284 tones (11,623 tons for feed processing).
5. Quantities of different quality dry omena for consumption; (ordinary quality = 4981.28 - 1000) = 3981.28 tons; high quality omena = 1000 tons).
6. Price of omena (Ksh. per kg.) including costs for feed quality Omena after primary and secondary processing by small scale processors, wholesalers, processors: producer = 44.85; primary processor = 61.45; wholesaler = 110; feed processor = 162.95.
7. Price (Ksh.) of dry Omena per kg. after primary processing; (ordinary omena = ((267 + 20.50 (cost) + 63 (profit)) = 350.50; wholesale processing = 480; high quality Omena = ((300 + 43 (cost) + 107 (profit) = 450.00)).
8. All ordinary quality Omena and feed quality product are sold by small scale processors to wholesalers (price of sale by small processors of ordinary quality to local retailers and wholesalers is about the same).
9. Weight of dry omena in a 2-kg tin = 500 grams (.5 kg) for human consumed fish.
10. One sack of feed quality Omena contains an average of 70 kg dry Omena.
11. The annual production of fresh Omena is equivalent to 1/3 of the dry product.
12. The quantity of high quality Omena processed and sold for human consumption is 1000 tons annually.
13. Most animal feeds are processed by large scale processors.
14. Note: Ksh. = Kenya shillings.

Estimates of values added as percentage at primary processing by small scale (women) processors, secondary processing by wholesalers, and tertiary processing by retailers and feed manufacturers were computed from the data and information above. The results are shown (Table 2).

Table 2: Omena value added at primary, secondary and tertiary processing in Omena value chain in Kenya

Omena value chain stage		Value added (%)		
		Ordinary quality Omena	High quality Omena	Feed quality Omena
Primary processing		31.3(267/350.50)	50.2(450.5/300)	37(61.50/45)
Secondary processing		37(480/350)	37(617/480)	79(110/61)
Tertiary processing	Retailer	23(590/480)	8(666/617)	-
	Feed processor	-	-	48(163/110)

Source: Own compilation

Note: Bracketed values separated by a slash are Omena product prices in Kenya shillings between consecutive value chain stages for the value addition activities between the stages.

The results indicate skewed distribution of value added within different value chain stages contrary to the findings for sea fish value chain fisheries in Morocco (INFOSAMAK, 2010) and retail frozen fish value addition in the UK (Roheim *et al*., 2007), showing problems of sustainability.

8. Discussion

Barriers to value addition in Omena rotate around lack of appropriate technology for sun drying Omena, poor adoption of a piloted sun drying technology, lack of legal and policy framework for processing dry Omena, and inadequate business and entrepreneurial skills among stakeholders in the value chain. Other barriers are under development of the value chain in terms of infrastructure, inadequate market information and stakeholder linkages among others, and lack of quality standards for handling and drying Omena due to lack of scientific studies as a basis for technical specifications crucial to food safety and human health. The other critical issues concern sustainability in the use of the resource and a balance in the use of Omena among local communities, high value markets and the animal feed industry.

For the new technology, further research should be conducted to identify factors which influence its diffusion such as institutional arrangements, technology characteristics, adopter characteristics, and how the nature of the social system in which the technology is under diffusion promotes or discourages diffusion of the technology among other factors. As regards space and land issues required for drying at landing sites, the roles of the National and County Governments in ensuring adequate land reflecting the total fishery production landed at the beaches cannot be overemphasized. Access to land for processing Omena by all processors must be equitable. Supporting facilities such as cold rooms, hygienic tap water and toilets must be adequately provided to ensure sanitary conditions. A balance must be struck between private and public utilization of infrastructures and land at the beaches. Realizations of these conditions would ensure high quality products and profitability for Omena businesses. There is need to constitute a committee of experts drawn from the public, civil society, Omena value chain stakeholders, university food science departments, processors and the private sector to draw standards for Omena processing. This will facilitate a huge access of the product to high value markets including export markets. Legal provisions and regulations for enforcing the standards by the State Department of Fisheries should be drawn by the expert committee. Market development capacity building should continue with clear assessment of capacity building needs which could be supported by taxes and levies from the product.

Removing barriers to value addition should be seen as a policy instrument for partly helping the government to make more food available especially to the riparian population. It should also be seen as a means of ensuring a balance for competition for Omena among local consumers, the animal feeds industry and high value markets. This should contribute resource use sustainability. Studies that establish factors determining the processing, storage and handling quality for Omena need to be embarked on to promote value addition to the product. A Hazard Analysis and Critical Control Point (HACCP) framework should also be established for use by the various stakeholders involved in the value chain.

Value addition analysis indicated that in general, there is a greater likelihood that businesses at the upstream end of the value chain gain least in value added at least for some of the Omena products compared to businesses at the downstream. This is illustrated by the lowest gain in value addition for ordinary Omena for small scale processors and high quality Omena for retailers. Wholesalers and feed manufacturers with better capital, market access information, technology and market power seemed in general to recoup the greatest gains in value added for at least feed quality Omena. The relatively high gain in value added to high quality Omena for human consumption by small scale processors illustrates that the introduction of technology, capital access for Omena processing and technical support can contribute to better competitiveness of small-scale processors in adding value to Omena compared to wholesalers and feed processors. It is important to note that feed quality Omena and ordinary human consumed quality Omena quantities and values added are about the same in proportion to each other. This means that the quality addition for ordinary Omena is not high enough given that there is relatively minimal quality addition for the feed quality Omena at small scale processor level. Second, it is important to notice the high figure of value added for high quality Omena and yet at the production-processor stage, it almost adds nil value to the value added at that stage of the value chain. This point concerns mainly the very limited quantity of high value Omena which has value added to it with a minimal cumulative value addition compared to the other products.

9. Conclusions

The following conclusions are made based on the study findings;

1. The barriers to value addition in Omena" value chain in Suba Subcounty such as poor processing technology, poor adoption of solar drying innovation, poor business skills, legal and policy framework shortcomings on dry Omena processing, land access and infrastructure development, and lack of technical specifications for processing and marketing Omena are contributing substantial losses of the product and impacting negatively on business profitability and food security especially for the locals.
2. The lack of information and linkages among fishermen, processors, wholesalers, and industrial processors means that the sharing of value addition benefits is unequal, and the value chain sustainability is threatened.
3. Because of the relatively large loss from quality and physical losses of the product, the value for money for the animal feeds manufactured from relatively low quality Omena may not be achieved by consumers of the feed products. This may be affecting animal production health and productivity.
4. The productivity of the Omena value chain is greatest for wholesalers and animal feed processors compared to small scale processors and retailers implying sustainability problems for the value chain because of inequitable share of benefits of the value chain.
5. Further value chain development, increasing access to capital, technology and technical support can help to reduce the gap in the advantage of value addition that wholesalers and animal feed processors have over retailers and small-scale processors. The productivity of the value chain will be enhanced when the barriers to value addition are addressed systemically by interventions in the whole value chain.

6. Capacity development for stakeholders on entrepreneurship and coordination, overcoming poor adoption of the new processing technology, appropriate legal and policy framework for processing dry Omena and infrastructure development are amongst the barriers to value addition that greatly impact value addition.
7. The market demand for Omena can be expanded when the value chain is developed by addressing the barriers to value addition and food security and when sustainability in use of the resource can be attained.

10. List of Abbreviations

CP – Crude Protein

FAO – Food and Agriculture Organization

GDP – Gross Domestic Product

GIZ – German Development Cooperation

HACCP – Hazard Analysis and Critical Control Point

INFOSAMAK – Centre for Marketing Information and Advisory Services for Fishery Products in the Arab Regions

KMFRI – Kenya Marine Fisheries Research Institute

NGOs – Non-Governmental Organizations

VA – Value Added

UK – United Kingdom

USAID – United States Agency for International Development

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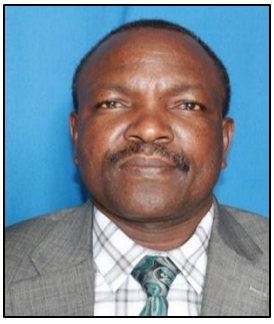
Authors Autobiographies with Photoes

Mathew A. Muma



Mathew Muma is a Senior Policy Analyst in agriculture and rural sector at the Kenya Institute for Public Policy Research and Analysis. Mathew has under taken programme implementation, monitoring and evaluation and policy research and analysis in agriculture for 26 years. He has undertaken research and policy analysis in sustainable agriculture, food and nutrition security and food value chain analysis with over ten publications including journal articles and technical papers. He recently published a Discussion Paper on the effects of capital assets on livelihood-based outcomes from livestock production among youth in the Semi-Arid Lands of Kenya. Additionally, he is working on a study on drivers of the under 5-year-old malnutrition in Kenya. You can reach him at mumadr@gmail.com

Harrison Charo-Karisa

Harrison Karisa-Charo is a Country Director for the World Fish for Egypt and Algeria, and is based at Cairo, Egypt. Harrison is an expert in fisheries and a specialist in aquaculture. He has worked in fisheries programming and policy implementation as an Acting Director at the State Department of Fisheries and the Blue Economy in the Ministry of Agriculture, Nairobi, Kenya. Harrison has undertaken research in aquaculture, reviewed research studies in fisheries policy research and supervised graduate students in fisheries studies. He has published many journal articles in aquaculture. You may reach him at hkarisa@kilimo.go.ke or charoh_se@yahoo.com.